

**What is claimed is:**

- 1) **In a fuel cell comprising:**
  - A) **a polymer electrolyte membrane;**
  - B) **a fuel electrode or anode;**
  - C) **an oxidation electrode or cathode; and**
  - D) **appropriate conductors for the supply of electrical current to an electrical load,**

**the improvement comprising the use of a porous, coal-based, carbon foam as either or both of said anode and said cathode.**
- 2) **The fuel cell of claim 1 wherein said coal-based carbon foam is semi-crystalline, largely isotropic, produced from particulate coal of a small diameter and exhibits a density of between about 0.1 and about 0.8 g/cm<sup>3</sup> and a thermal conductivity of below about 1 W/m/°K.**
- 3) **The fuel cell of claim 2 wherein said small diameter is less than about 1 mm.**
- 4) **The fuel cell of claim 2 wherein said coal-based carbon foam has a compressive strength below about 6000 psi.**

- 5) The fuel cell of claim 1 wherein said coal-based carbon foam is prepared from bituminous coal.
- 6) The fuel cell of claim 4 wherein said bituminous coal has a swell index of between about 3 and about 5.
- 7) The fuel cell of claim 4 wherein said bituminous coal has a Gieseler plasticity value above about 500DDPM.
- 8) The fuel cell of claim 2 wherein coal-based carbon foam exhibits a pore size below about 2000 $\mu$ .
- 9) The fuel cell of claim 8 wherein said coal-based carbon foam exhibits a pore size below about 100 $\mu$ .
- 10) The fuel cell of claim 2 wherein said coal-based carbon foam has been graphitized at a temperature between about 1600°C and 2600°C.
- 11) The fuel cell of claim 9 wherein said coal-based carbon foam has been graphitized at a temperature between about 1800°C and about 2200°C.

**12) The fuel cell of claim 9 wherein said coal-based carbon foam has been graphitized at a temperature of about 2200°C.**

**13) The fuel cell of claim 2 wherein said coal-based carbon foam is prepared by a process comprising the steps of:**

- A) comminuting coal to a small particle size to form a ground coal;**
- B) placing said ground coal in a mold;**
- C) heating said ground coal in said mold under a non-oxidizing atmosphere to a temperature of between about 300° C and about 700° C and soaking at this temperature for a period of from about 10 minutes to about 12 hours to form an electrode preform;**
- D) controllably cooling said electrode preform; and**
- E) graphitizing said electrode preform at a temperature between about 1600°C and 2400°C.**

**14) In an electrical cell for the generation or storage of electrical power through an electrochemical reaction and comprising:**

- A) an anode;**
- B) a cathode; and**
- C) appropriate conductors for the supply of electrical current to an electrical load,**

**the improvement comprising the use of a porous carbon foam  
as either or both of said anode and said cathode.**

**15) The electrical cell of claim 13 wherein said porous carbon foam is  
coal-based.**

**16) The electrical cell of claim 14 wherein said coal-based carbon foam  
is derived from a coal having a swell index of between about 3 and  
about 9.**

**17) The electrical cell of claim 15 wherein said swell index is about 4.**

**18) The electrical cell of claim 14 wherein said carbon foam is derived  
from a coal having a Gieseler plasticity value above about 500  
DDPM.**

**19) The electrical cell of claim 14 wherein said carbon foam semi-  
crystalline, largely isotropic, produced from particulate coal of a  
small diameter and exhibits a density of between about 0.1 and  
about 0.8 g/cm<sup>3</sup> and a thermal conductivity of below about 1  
W/m/°K.**

20) The electrical cell of claim 18 wherein said small diameter is less than about 1 mm.

21) The electrical cell of claim 18 wherein said carbon foam has a compressive strength below about 6000 psi.

22) The electrical cell of claim 14 wherein coal-based carbon foam exhibits a pore size below about 2000 $\mu$ .

23) The electrical cell of claim 21 wherein said coal-based carbon foam exhibits a pore size below about 100 $\mu$ .

24) The electrical cell of claim 14 wherein said coal-based carbon foam has been graphitized at a temperature between about 1600°C and 2600°C.

25) The electrical cell of claim 23 wherein said coal-based carbon foam has been graphitized at a temperature between about 1800°C and about 2200°C.

26) The electrical cell of claim 24 wherein said coal-based carbon foam has been graphitized at a temperature of about 2200°C.

**27) The electrical cell of claim 14 wherein said carbon foam is prepared by a process comprising the steps of:**

- F) comminuting coal to a small particle size to form a ground coal;**
- G) placing said ground coal in a mold;**
- H) heating said ground coal in said mold under a non-oxidizing atmosphere to a temperature of between about 300° C and about 700° C and soaking at this temperature for a period of from about 10 minutes to about 12 hours to form an electrode preform;**
- I) controllably cooling said electrode preform; and**
- J) graphitizing said electrode preform at a temperature between about 1600°C and 2400°C.**